

AEROLOGICAL ACTIVITIES AT THE NAVAL AIR STATION, SAN DIEGO, CALIF.: HISTORICAL SKETCH

W. G. LINDEMAN

Aerographer, Second Class, U. S. Navy

[San Diego, Calif.]

The aerological observatory at the naval air station, San Diego, Calif., has reached its present development mainly under two objectives: First, the dissemination of weather information to the various aviation units operating at the air station; second, the making of an aerological survey by means of pilot-balloon soundings, the collection of data of temperature and humidity of the upper air in that vicinity with an aerograph by the aid of an airplane, and the furnishing of these data to the various aviation units operating at the air station.

From November 1917, which was the beginning of naval aviation at North Island, to June, 1921, little can be said about the aerological activities, due to the following reasons taken from a report of the aerographic department for the fiscal year ending June 30, 1921:

On July 1, 1920, the aerographic department of this station was for the first time since the fire, which occurred in September, 1919, fairly well equipped with aerographic instruments.

Prior to May, 1920, this office was greatly handicapped by the lack of trained personnel to carry on the work. In May, an officer who was a trained meteorologist, was ordered to this station for duty. Upon his arrival he found everything in more or less chaotic state due to the fire, which has practically destroyed all the aerographic instruments.

The main difficulty in carrying on the aerographic work has been due to the lack of trained personnel. From the time that the aerological office was established to within the last five years, the personnel included a commissioned officer in charge, while the work was carried on by enlisted personnel, which usually consisted of an assistant who has previous training in the aerological school at Pensacola, Fla., and one or two untrained enlisted men taken at random from any other branch of the Naval Air Service regardless of qualification.

The present aerographer's rating was established in December, 1923, and during 1924 the aerographers school was inaugurated at Washington, D. C., under the direct supervision of Lieutenant Reichelderfer who also has supervision of the aerological branch of the United States Navy, and much credit is due him for its development.

Requirements for entrance are two completed years in high school, or high-school credits in physics, geometry, algebra, and physical geography. Sixteen weeks are required to finish the course of instructions, which embraces physics, mathematics, meteorology, typing, and practical work. Upon completion the graduates are detailed to the various aerological offices ashore and afloat.

In the aerological branch of the Navy there are four ratings; third class, second class, first class, and chief aerographer. Upon completion of the prescribed curriculum at the school, the student is qualified to take the examination for the third-class rating of aerographer. For advancement to the higher ratings, one year's service is required in the next lower rating before becoming eligible for examination for the next higher.

Pilot-balloon soundings have been made by the single theodolite method since July, 1920. Of course, morning soundings are lacking in continuity, due to low clouds or fog; to the fact that none are made on holidays and Sundays; and to the lack of balloons or gas. But we have a

much better and more complete record of the afternoon soundings.

Beginning with the summaries in 1924 both morning and afternoon soundings show a very marked improvement in continuity and elevations reached.

The aerograph flights began in 1923, but prior to 1924 the record is sporadic for such reasons as hazardous weather conditions, lack of aeroplanes, and the securing of operations at the station.

LOCATION OF OFFICE AND ITS EQUIPMENT

Our observatory is located on the three upper floors of the tower of the administration building, where its equipment has been permanently installed since 1922.

The instrument shelter and two theodolites are located on the top of the tower, 130 feet above the ground. It is necessary to have two theodolites for use because the balloon is sometimes obscured by the mast on the top of the tower on which the wind vane for the anemobiograph and the 3-cup anemometer is mounted.

We are justly proud of our equipment, as we are fully supplied with the instruments necessary for the recording of weather conditions and aerological survey work.

One apparatus of great importance that is used for recording wind direction and velocity simultaneously, and not usually found in United States Weather Bureau offices, is the anemobiograph made by Negretti and Zambra of London. This instrument is designed upon the Dines model, and writes directly the wind direction and velocity and in this manner indicates its gustiness.

The sunshine recorder is not the type adopted by the Weather Bureau, but is designed upon the Campbell-Stokes principle. It consists essentially of two parts: A glass sphere which brings the sun's rays to a focus, and a metal bowl carrying cards to form a belt, approximately spherical, on which the sun burns a record. On this card are vertical-line graduations for determining the hours that the sunshine occurred.

Standard instruments and equipment are used for obtaining aerographic and pilot-balloon sounding data, except that the aerograph is taken aloft by aeroplane instead of kite and the Friez type of instrument is used.

The pilot-balloon plotting board is so constructed that by using a celluloid disk with its outer edge graduated to 360°, and then plotting the horizontal distance and the azimuth angle on this celluloid disk, the wind direction and velocity may easily and readily be obtained for each minute.

Due to the fact that the tower is visible from all points in the harbor, and to the south at sea, on January 1, 1925, the office was designated a storm-warning display station of the Weather Bureau.

PERSONNEL

At present there are three aerographers assigned to our office for duty: Chief aerographer, A. A. Stotts; aerographer, second class, W. G. Lindeman; and aerographer, third class, R. P. Darr.

While virtually under the direct supervision of Lieut. W. K. Berner, the work is carried on by the aerographers.

In addition to the office routine, military duties must be performed according to regulations.

OBSERVATIONAL

Two copies of the aerological observations are entered concurrently each day in the forms prescribed. Originals are invariably forwarded to the Bureau of Aeronautics, aerological section, and one copy is filed in our office.

The assembled form contains data of surface observations, pilot balloon observations, aerograph soundings, copies of instrument record traces and a summary of the surface readings for the month.

These latter are made three times a day; at 8 a. m., 12 noon, and 4 p. m., one hundred and twentieth, meridian time. In addition to the regular observations of weather conditions, visibility, conditions of landing area and the number of hours of favorable flying weather are recorded. Visibility is recorded according to the standard scale of 0 to 9, and favorable flying weather is defined as weather in which the wind velocity is not over twenty miles per hour, the clouds, if any, are not below 4,000 feet, the visibility is not less than scale 4 (2.5 miles), there is no precipitation, and the temperatures are not below zero, Fahrenheit.

From the 1st of June of this year, we are recording water temperatures in San Diego Bay daily at 8 a. m., 12 noon, and 4 p. m., taking the readings from the air station catapult dock at a depth of approximately 20 feet. Observations include the following: Psychrometric data; temperature of surface water; temperature of water at bottom; tide periods, that is, high or low tide.

One of the two major aerological observations are pilot-balloon soundings, which are made by single theodolite methods at 7 a. m. and 1 p. m., regardless of weather conditions or height of clouds, with the exception that the 7 a. m. sounding is not made on Sundays and holidays. Special readings are taken at any time upon request from the various aviation units operating at North Island. Soundings that are taken at night are usually made to obtain upper air data for night flying. The only change in the method of making these is that a tissue paper lantern with a lighted candle is fastened on the balloon by a piece of tape. To compensate for this extra weight, the lantern and candle are weighed together to determine the amount of hydrogen to use in inflating the balloon so as to give it the rate of ascent that is being used. Then when the balloon is released the light from this lantern is observed through the theodolite.

A system for increasing the speed of the computations of the soundings was put into practice during April of this year by installing a telephone from the point of observation to the plotting room two stories below. Two men are required to make a sounding by this system. The observer at the theodolite is equipped with a headset and mouthpiece and as he reads the angles of elevation and azimuth at the 1 minute intervals, his assistant at the receiving end records these data and computes the horizontal distances by slide rule. He then plots these data on the board, and obtains the wind direction and velocity. Consequently at the end of the sounding the entire report is complete, thus saving the additional time required of plotting after the sounding has been made.

In addition to furnishing a report of the pilot-balloon soundings to the various aviation units, a coded message of the 7 a. m. and 1 p. m. soundings is sent to the Weather Bureau office at San Francisco, via naval radio, in return for which we receive the daily weather forecast for Southern California.

The other major aerological observation is the aerographical flight. Our office is one of the few having equip-

ment for the making of observations by aeroplane, and a distinct advance was made recently when we adopted the adiabatic graph for charting.

FORECASTING

Previous to the change in the methods of receiving their reports, the weather data for the drawing of the synoptic chart and making of the forecast was obtained from the Weather Bureau office at San Diego. Now the communication office at the Naval Air Station copies the 6:15 a. m. weather report broadcasted from San Francisco by naval radio. This bulletin contains current weather observations from stations in the United States, Canada, Alaska and also ship reports. The 7:30 a. m. and 7:30 p. m. weather bulletins which contain weather reports, information, forecasts, and storm warnings for the benefit of marine and aviation interests, also including aerological data from various western stations, are also copied.

From these reports the a. m. weather map is completed at 8:15, three copies of which are distributed for reference to various places in the administration building. One evening map is drawn for the office files from the 7:30 p. m. broadcast.

Each morning a bulletin is prepared consisting of the latest weather reports from important cities and air bases, giving in detail the time of observation, conditions of sky, state of weather, lowest clouds and height in feet, visibility, conditions of landing field, winds—direction and velocity at surface and at 5,000 feet—and the outlook for flying. The detailed aviation weather forecast for this locality covers the periods of "to-day," "to-night," and "to-morrow," giving in detail expected cloud ceiling, visibility, etc., of value for flight operations.

In our forecast verification absolute exactness is unnecessary because the purpose of the forecast is to meet the practical needs of naval aviation, and there are certain limits within which variations in weather conditions are of little significance. Consequently tolerances, based upon the needs of aviation, are allowed in the verifications.

As the Army at Rockwell field occupies the southern section of the island and the naval air station, fleet air squadrons, and the Marine Corps aviation group are combined on the northern section, all operations are consequently close together. Forecasts are issued to the last three groups, but we are not allowed, by orders, to issue them to civilian pilots or commercial aviation organizations.

Copies of the weather bulletin are distributed to the commanding officer, executive officer, officer of the day, Naval Air Station operations office, fleet air officer of the day, land-plane squadrons, sea-plane squadrons, and Marine Corps aviation group office.

Special forecasts are issued for cross-country flying and forecasts for this vicinity are also sent by radio to various ships of the Navy along the coast when requested.

FUTURE DEVELOPMENTS

Steps have been taken for future expansion by the installation of equipment at three places in San Diego County, for the purpose of locating the best prospective sites for an airship base.

Each equipment consists of instruments for recording wind velocity, gusts, and direction, air temperature, humidity, sun temperature, which by comparison with air temperature in the thermo-screen, gives the amount of sunshine. Statistics of these elements are required in order to determine matters of hangar orientation and general suitability for the operation of airships.

With an increasing trained personnel it is hoped that a definite program of research and correlation can be carried

out, which will ultimately give us a better conception of the processes connected with the formation and dissipation of fog—aviations greatest hazard. With an increasing number of aerological observations, local problems connected with the upper air such as temperature inversions, turbulences, eddies, unexplained wind directions, etc., can be charted and given serious consideration.

If the results of our studies have done nothing else, they have proved conclusively that death pockets, holes in the air, death spots, etc., are all phantasies of publicity seekers in the super-sensational Sunday supplements.

For a bureau in its infancy we have made rapid strides and there is little doubt in my mind that the solution of many of the problems of meteorology will be found in the records which we are accumulating.

A 12-YEAR RECORD OF HOURLY TEMPERATURES AT RICHMOND, VA.

By H. A. FRISE

[Local Weather Bureau Office, Richmond, Va.]

In presenting the 12-year record of hourly temperatures 1911-1922, the results are not offered as representing mean temperatures that are normal to this locality, but rather to show the magnitude of the difference between mean temperatures derived from but two points on the daily curve, the maximum and the minimum, and those derived from the mean of the 24 hours. For practical purposes the mean of the extremes is quite close to the true mean for a good part of the year, though for the warm months there is a considerable departure. There is no doubt that for all lengths of record the mean of the daily extremes departs most from the 24-hour mean. (See fig. 1.)

Whether the departure, say for July, is as great for a 40-year period as for one of but 10 years has not been determined because of the large amount of labor involved, but it is not believed that a long record would alter the comparative result of a 12-year record materially.

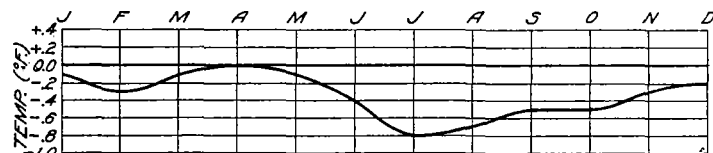


FIG. 1

Table 1 shows the winter, summer, and annual mean temperature as derived from means of the 24 hours for the years above named and figure 1 shows the variation of the means derived from the daily extremes from the means of the 24 hours.

In Table 2 I have given the summer and winter mean range, as computed from (a) the readings of self-registering maximum and minimum thermometers, and (b) from corrected readings of the thermograph for the warmest and the coldest hours of the day, respectively. For winter the hours of 7 a. m. and 3 p. m. have been chosen and for summer 5 a. m. and 3 p. m.

This table shows that the range computed from self-registering thermometers is for winter 17.9° and for summer 19.6°. The mean range between the warmest and the coldest hours, respectively, is for winter but 12.6° or 5.3° less than from self-registering thermometers as might be expected. In summer the difference is less, being but 2.4°. This is explained by the fact that the winter mean for January, for example, rises but 0.2° farther above the mean of the 24 hours than the minimum sinks below it, whereas in July the maximum, 87.1°, rises 1.4° farther above than the mean minimum falls below it. This excess in the maximum temperature explains the larger deviation of the July mean of the daily extremes from the mean of the 24 hours. It would be interesting to see whether this excess in the maximum temperature in summer holds for other places than Richmond. Strictly speaking, the mean of the 3 p. m. temperatures should not be the same as that of the daily maximum thermometer.

TABLE 2.—Comparison of monthly range in temperature as obtained (a) from readings of maximum and minimum thermometers and (b) from readings of thermograph (corrected) at hours of highest and lowest temperatures, respectively

FROM MAXIMUM AND MINIMUM THERMOMETERS

	Maximum	Minimum	Range		Maximum	Minimum	Range
December.....	48.0	31.0	17.0	June.....	83.4	63.3	20.1
January.....	47.3	29.3	18.0	July.....	87.1	67.7	19.4
February.....	48.7	29.9	18.8	August.....	85.8	66.4	19.6
Mean.....	48.0	30.1	17.9	Mean.....	85.4	65.8	19.6

FROM HOURLY MEANS OF WARMEST AND COLDEST HOUR

	Maximum 3p	Minimum 7a	Range		Maximum 3p	Minimum 5a	Range
December.....	43.4	34.2	12.2	June.....	82.0	64.3	17.7
January.....	44.8	33.1	11.7	July.....	85.5	68.7	16.8
February.....	46.6	32.6	14.0	August.....	84.4	67.5	16.9
Mean.....	45.9	33.3	12.6	Mean.....	84.0	66.8	17.2

TABLE 1.—Mean hourly temperatures, the year, and for winter and summer at Richmond, Va., 1911-1922

YEAR																									
A. M.												P. M.												Mean	Mean of extremes same period
1	2	3	4	5	6	7	8	9	10	11	Noon	1	2	3	4	5	6	7	8	9	10	11	Mid-night		
53.0	52.2	51.5	50.9	50.3	50.2	51.0	52.9	56.2	59.1	61.5	63.4	64.9	65.8	66.1	65.7	64.4	62.5	60.4	58.6	56.7	55.1	54.6	53.7	57.5	57.9
WINTER																									
36.0	35.5	34.9	34.4	33.8	33.6	33.3	33.7	35.5	38.1	40.6	42.7	44.4	45.4	45.9	45.6	44.4	42.8	41.3	40.2	38.9	37.9	37.3	36.6	38.9	39.0
SUMMER																									
69.4	68.7	68.0	67.4	66.8	67.1	69.0	71.9	75.5	78.3	80.4	81.9	83.2	83.9	84.0	83.3	82.1	80.4	77.9	75.6	73.5	71.9	71.1	70.1	75.1	75.7